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INT CL[7] G01S 3/786 , G06K 9/00 , G06T 7/00 , G08B 13/194 13/196 15/00
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(54) Abstract Title
Photographing or recognising a face

(57) For intelligently photographing or recognising a face, the position of the face is identified in an image from a camera (10), a check area is selected in order to track the face, and the pan/tilt or zoom of the camera are controlled (20) to track the identified face. Presence of a face and whether the face is abnormal eg masked is determined by analysing the contour of the face. The eyes, nose and mouth may be checked, and an alarm may be generated (60) if a dangerous person is detected. The image of the face may be stored (50) and used for identification of a person, or transmitted to another location. The image may be analysed for areas of skin colour or movement.

FIG. 2

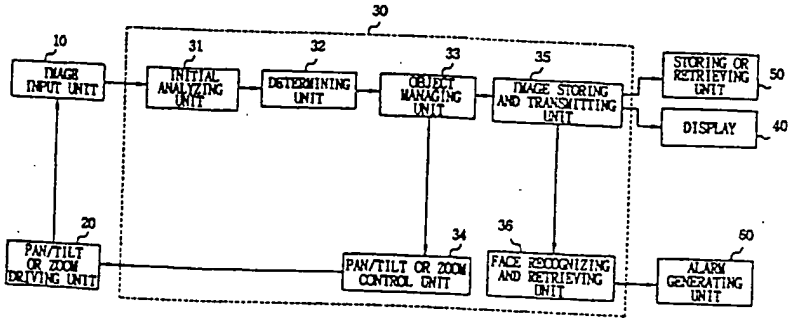

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FIG. 1

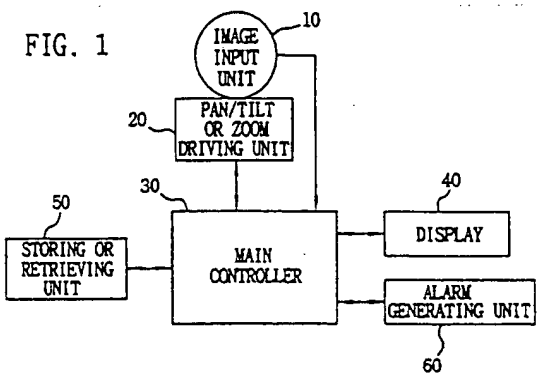


FIG. 3

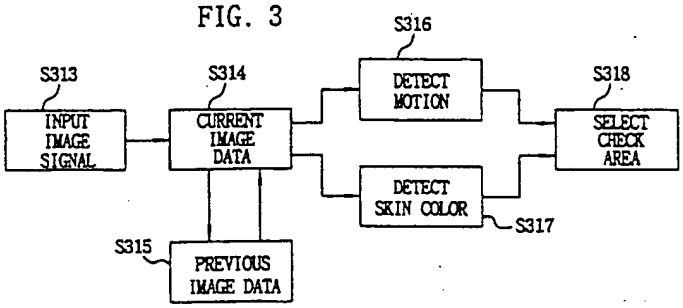


FIG. 4

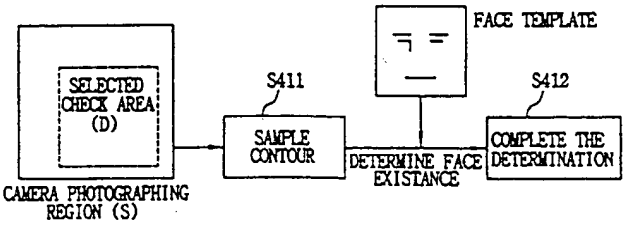


FIG. 2

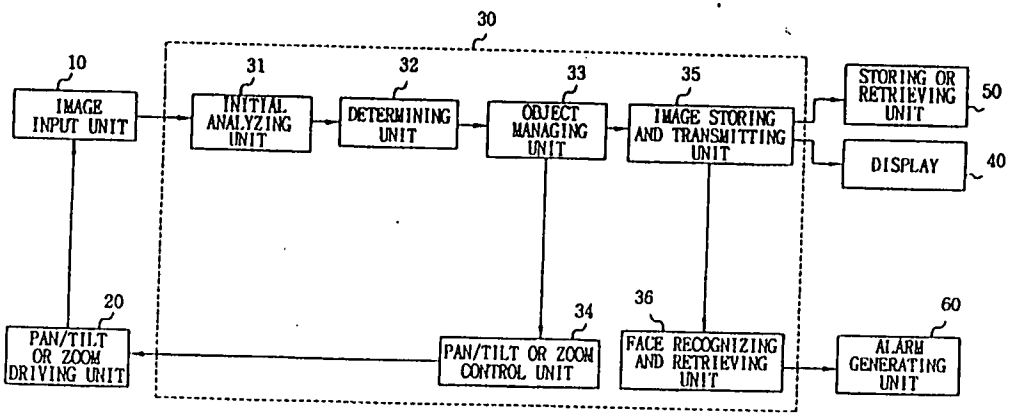

30
10
IMAGE INPUT UNIT
31
INITIAL ANALYZING UNIT
32
DETERMINING UNIT
33
OBJECT MANAGING UNIT
35
IMAGE STORING AND TRANSMITTING UNIT
STORING OR RETRIEVING UNIT
50
DISPLAY
40
20
PAN/TILT OR ZOOM DRIVING UNIT
34
PAN/TILT OR ZOOM CONTROL UNIT
36
FACE RECOGNIZING AND RETRIEVING UNIT
60
ALARM GENERATING UNIT

FIG. 5

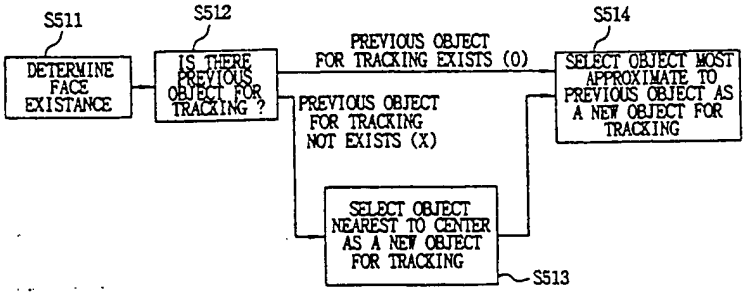

S511
DETERMINE FACE EXISTANCE
S512
IS THERE PREVIOUS OBJECT FOR TRACKING ?
PREVIOUS OBJECT FOR TRACKING EXISTS (O)
PREVIOUS OBJECT FOR TRACKING NOT EXISTS (X)
S514
SELECT OBJECT MOST APPROXIMATE TO PREVIOUS OBJECT AS A NEW OBJECT FOR TRACKING
SELECT OBJECT NEAREST TO CENTER AS A NEW OBJECT FOR TRACKING
S513

FIG. 6

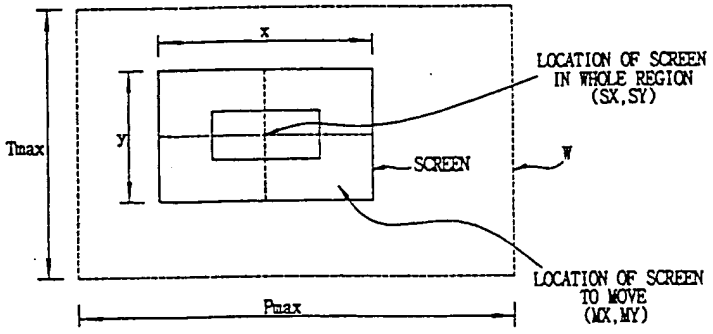

x
y
Tmax
Pmax
LOCATION OF SCREEN IN WHOLE REGION (SX,SY)
SCREEN
W
LOCATION OF SCREEN TO MOVE (MX,MY)

FIG. 7

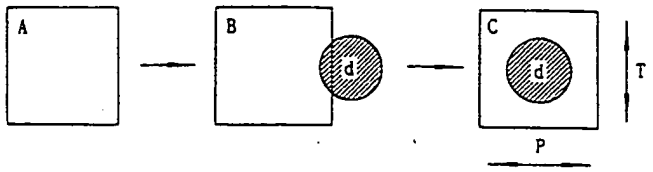


FIG. 8

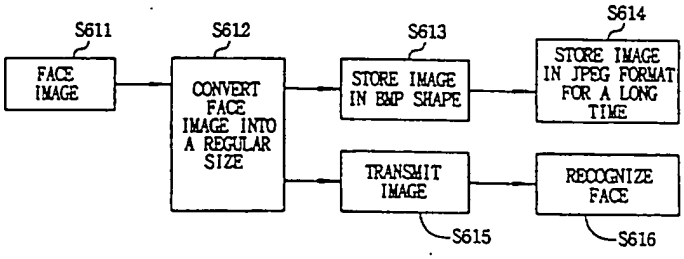


FIG. 9

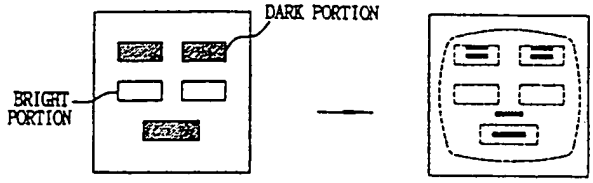


FIG. 10

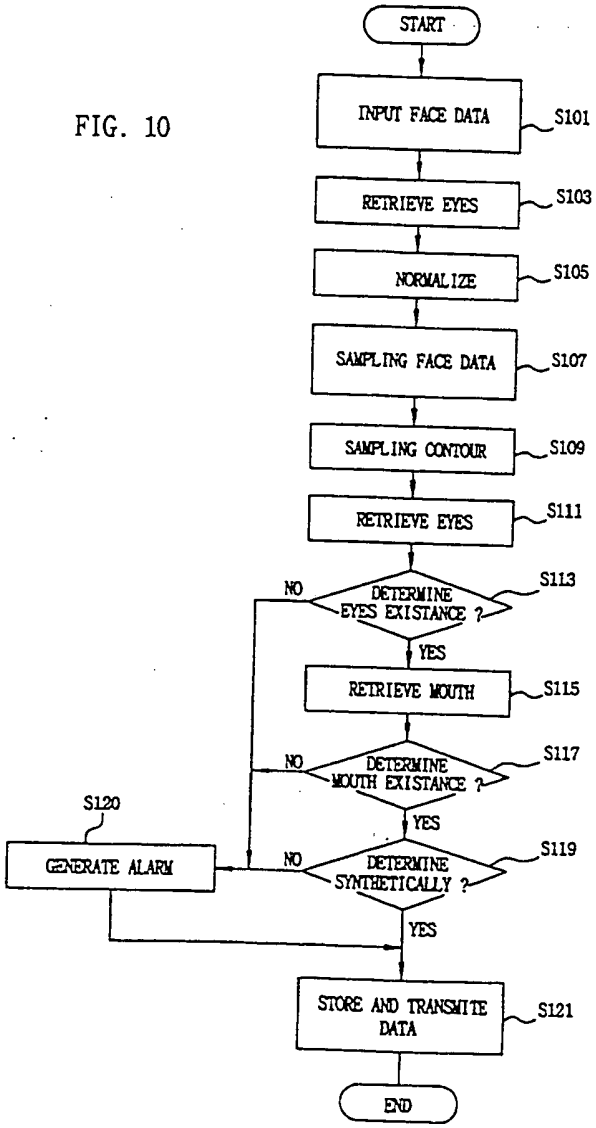

START
INPUT FACE DATA
S101
RETRIEVE EYES
S103
NORMALIZE
S105
SAMPLING FACE DATA
S107
SAMPLING CONTOUR
S109
RETRIEVE EYES
S111
DETERMINE EYES EXISTANCE ?
S113
NO
YES
RETRIEVE MOUTH
S115
DETERMINE MOUTH EXISTANCE ?
S117
NO
YES
S120
GENERATE ALARM
DETERMINE SYNTHETICALLY ?
S119
NO
YES
STORE AND TRANSMITE DATA
S121
END

FIG. 11

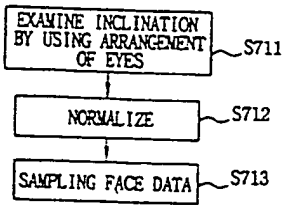


FIG. 12

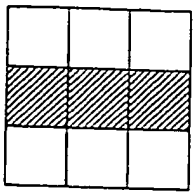


FIG. 13

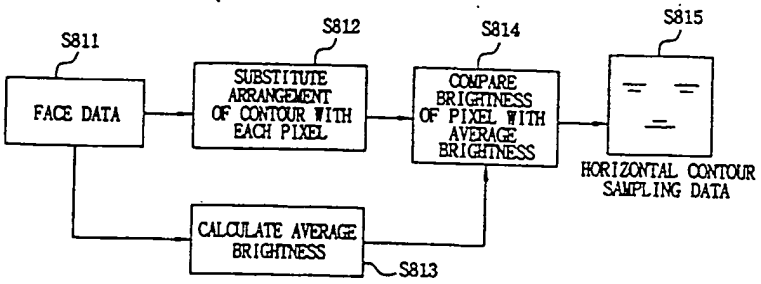


FIG. 14

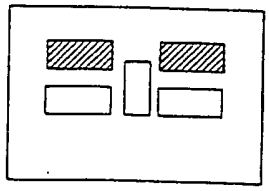
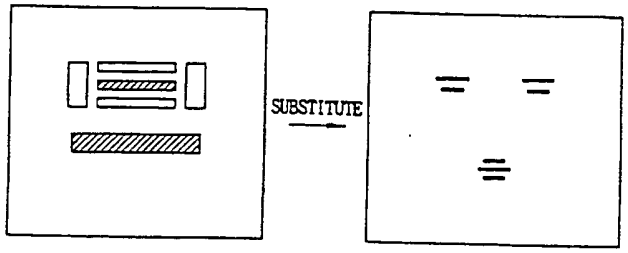


FIG. 15



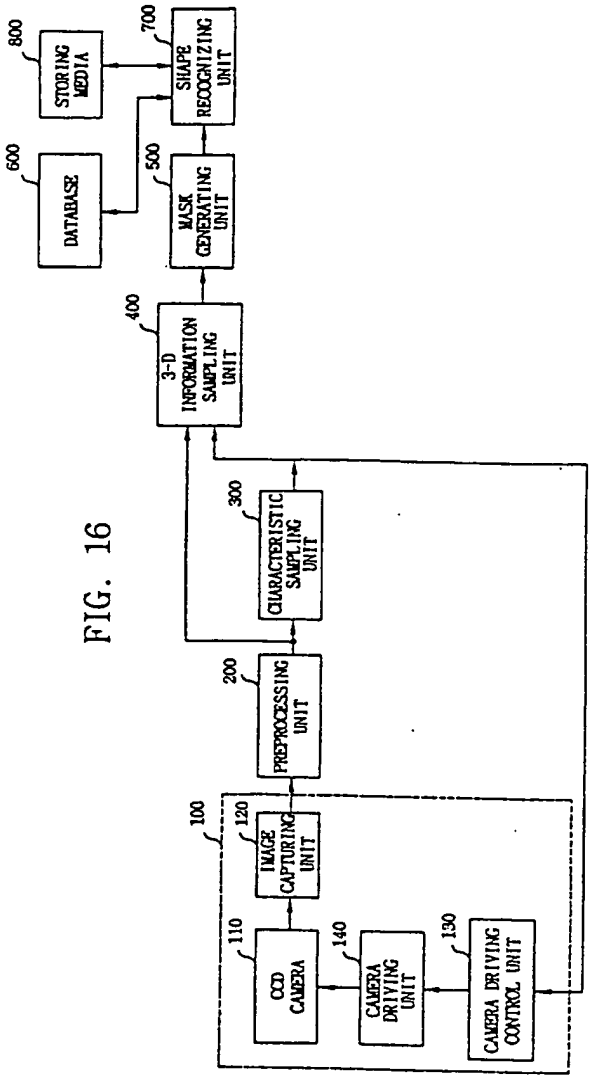
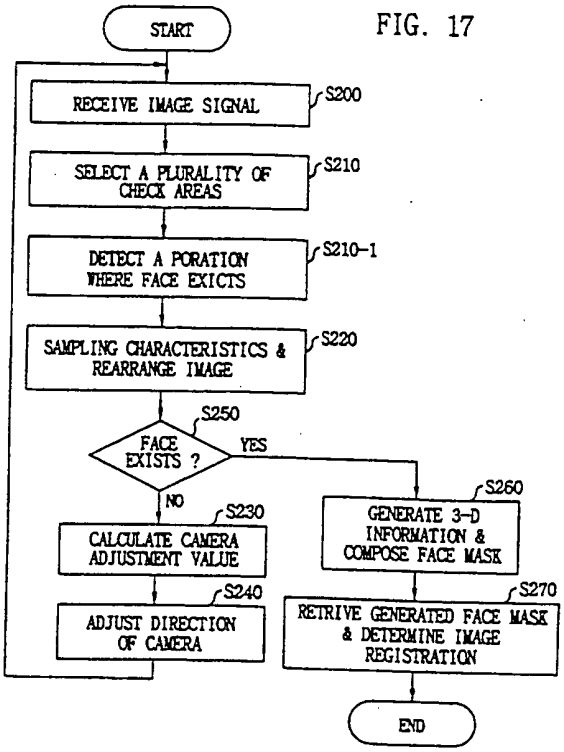

100
110
CCD CAMERA
120
IMAGE CAPTURING UNIT
130
CAMERA DRIVING CONTROL UNIT
140
CAMERA DRIVING UNIT
200
PREPROCESSING UNIT
300
CHARACTERISTIC SAMPLING UNIT
400
3-D INFORMATION SAMPLING UNIT
500
MASK GENERATING UNIT
600
DATABASE
700
SHAPE RECOGNIZING UNIT
800
STORING MEDIA

FIG. 16

FIG. 17


START
RECEIVE IMAGE SIGNAL
S200
SELECT A PLURALITY OF CHECK AREAS
S210
DETECT A PORATION WHERE FACE EXICTS
S210-1
SAMPLING CHARACTERISTICS & REARRANGE IMAGE
S220
S250
FACE EXISTS ?
YES
NO
S230
CALCULATE CAMERA ADJUSTMENT VALUE
S240
ADJUST DIRECTION OF CAMERA
S260
GENERATE 3-D INFORMATION & COMPOSE FACE MASK
S270
RETRIVE GENERATED FACE MASK & DETERMINE IMAGE REGISTRATION
END

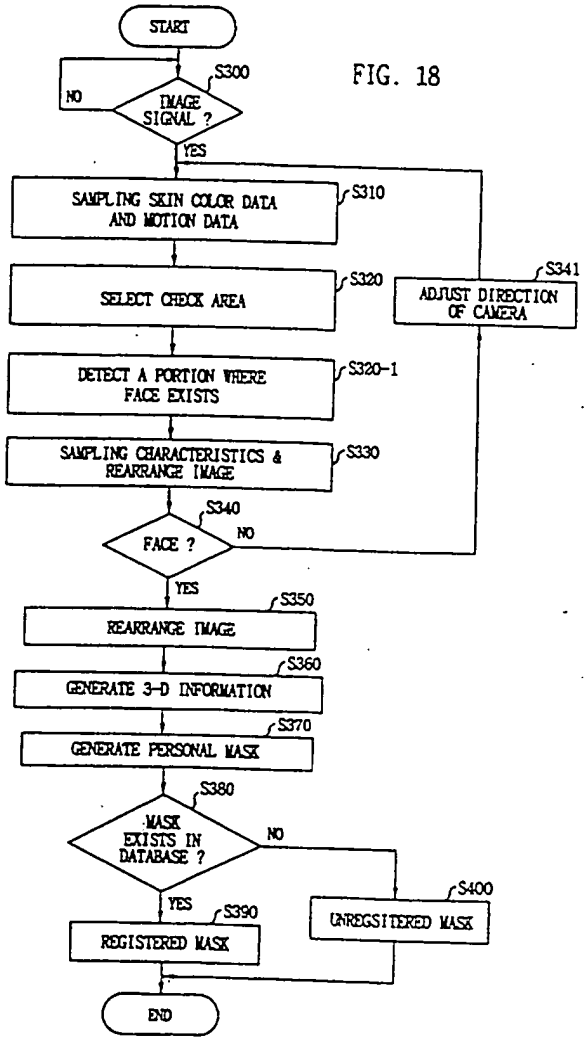

START
S300
NO
IMAGE SIGNAL ?
YES
SAMPLING SKIN COLOR DATA AND MOTION DATA
S310
SELECT CHECK AREA
S320
S341
ADJUST DIRECTION OF CAMERA
DETECT A PORTION WHERE FACE EXISTS
S320-1
SAMPLING CHARACTERISTICS & REARRANGE IMAGE
S330
S340
FACE ?
NO
YES
S350
REARRANGE IMAGE
S360
GENERATE 3-D INFORMATION
S370
GENERATE PERSONAL MASK
S380
MASK EXISTS IN DATABASE ?
NO
YES
S390
REGISTERED MASK
S400
UNREGSITERED MASK
END

FIG. 18

METHOD AND APPARATUS FOR PHOTOGRAPHING/RECOGNIZING A FACE

BACKGROUND OF THE INVENTION

1. Technical field

The present invention relates to method and apparatus for photographing/recognizing a face which can intelligently photograph an object captured by a camera. Particularly, the present invention relates to method and apparatus for photographing/recognizing a face which may distinguish a specific person by photographing and recognizing a face portion of the person accurately through adjusting the camera according to motion of the object, and generate alarm to a dangerous character so to be applied to a security system, an image recognizing system, a picture telephone, an internet on-line game and a virtual reality system, etc.

2. Description of the Prior Art

In order to photograph a face, a conventional manless monitoring or face recognizing system employs at least one monitoring camera installed in a desired position such as ceiling or wall. With use of image signals from the camera, the conventional system enables to remotely monitor a specific field or manlessly record whole scene of the field. Such systems are usually used for judging condition of a specific field.

However, such manless monitoring system or face recognizing

system should capture image signals of the field from a designated position (such as height or distance). Therefore, the image signals are irregular due to variation of height of an object or distance between the object and the camera. Furthermore, an object or face which is hid or moves fast to get away the camera can be hardly recognized. Recognizable image signals can be just obtained by photographing the object in front or artificially adjusting the camera with use of a remote controller or a direction adjusting key.

Therefore, the conventional system has trouble to recognize a face in moving pictures with use of such unrecognizable image data. Because it is very difficult to find an intact face image through retrieving a stored data, the image data obtained as above cannot provide sufficient evidence when security problem happens. In addition, because the stored data is in type of moving pictures, it needs a high-capacity storing unit for storing such moving pictures, unnecessarily.

In order to overcome such problems, there is needed to develop technique for photographing a face image in front more accurately by moving the camera according to motion of the object.

SUMMARY OF THE INVENTION

The present invention is designed to solve such problems. An object of the present invention is to provide method and apparatus for

photographing a face which can photograph a face image in a still picture by detecting skin color and motion of an object captured by a camera, automatically selecting most appropriate object, and making the camera track the object automatically without any artificial manipulation, and method and apparatus for recognizing a face which can accurately recognize a specific person by analyzing the face image of the captured object.

Another object of the present invention is to provide method and apparatus for recognizing a face which can cope with any possible emergency in advance by identifying a face having risk factors (such as strange mask, dark sunglasses, pressed-down cap, etc.) through analyzing the face image signals of the selected object, and generating alarm to a dangerous person.

In order to obtain above object, one embodiment of the present invention provides a method of photographing a face comprising: initial analyzing step for identifying position of the face by sampling face data from image signals inputted from a camera installed in a predetermined position, and then selecting check area in order to track the identified face; pan/tilt or zoom control step for moving the camera to right/left, up/down or forward/backward direction in order to track the identified face in the selected check area; determining step for determining whether the face is existing or abnormal by sampling and analyzing contour of the face

identified in the check area; and storing and transmitting step for storing image of the determined face or transmitting the image to another recognizing system.

In the embodiment, the method of photographing a face may further include the step of generating alarm about abnormal face after analyzing and determining the contour of the face sampled in the check area.

In order to accomplish the above objects, another embodiment of the present invention provides a method for recognizing a face comprising: initial analyzing step for identifying position of the face by sampling face data from image signals inputted from a camera installed in a predetermined position, and then selecting check area in order to track the identified face; pan/tilt or zoom control step for moving the camera to right/left, up/down or forward/backward direction in order to track the identified face in the selected check area; determining step for determining whether the face is existing or abnormal by sampling and analyzing contour of the face identified in the check area; and composing a personal mask by generating 3-dimensional information for a face image in the check area in case that the face is existing, and then recognizing a specific person by comparing the personal mask with a previously stored personal mask.

For obtain the above objects, still another embodiment of the present invention provides a method for recognizing a face comprising the

steps of: selecting a plurality of check areas about image signals captured by a camera, selecting a specific check area by determining whether a face exists in the corresponding check area, and adjusting direction of the camera according to motion of an object in the selected check area; rearranging images by detecting characteristics about image signal where a face is existing in the check area after determining whether a face exists, generating 3-dimensional information according to displacement between the rearranged images, and composing a face mask of the object with use of the 3-dimensional information; and determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in a database.

For accomplish the above objects, another embodiment of the present invention provides a method for recognizing a face comprising the steps of: selecting a plurality of check areas by respectively sampling skin color data and motion data from image signals inputted through a camera, selecting a specific check area by retrieving a specific check area by inspecting face components about image signals in the corresponding check area, rearranging image by retrieving characteristics of the selected check area, and adjusting direction of the camera with determining whether a face exists or not with use of the rearranged image; rearranging images about image signals where a face is existing in the check area, generating 3-dimensional information according to displacement between

the rearranged images, and composing a personal face mask by comparing the 3-dimensional information with a reference mask; and determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in a database.

For accomplish the above objects, the present invention also provides an apparatus for photographing a face comprising: image input means for capturing image of an object photographed by a camera installed in a predetermined position, and receiving serial image signals; pan/tilt or zoom driving means for moving the camera of the image input means to right/left, up/down or forward/backward direction; main control means for controlling the pan/tilt or zoom driving means such that the camera tracks motion of the object, selecting a check area by detecting skin color and motion of the object from the image signals inputted from the image input means, retrieving face portions from the image signals in the selected check area, and storing and displaying the face portions; storing or retrieving means for storing the image signals from the main control means or retrieving face portion from the image signals; and display means for outputting the image signal corresponding to the face portion outputted from the main control means.

In the embodiment, the apparatus for photographing a face may further include an alarm generating unit for generating alarm about abnormal face after analyzing and determining the contour of the face

sampled in the check area.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings, in which like components are referred to by like reference numerals. In the drawings:

FIG. 1 is a schematic block diagram for showing configuration of method for photographing/recognizing a face according to one embodiment of the present invention;

FIG. 2 is a functional block diagram for showing a main controller shown in FIG. 1;

FIG. 3 shows signal flow of an image input process;

FIG. 4 shows signal flow of an initial analyzing process;

FIG. 5 shows signal flow of a determining process;

FIG. 6 is a reference showing a screen and a screen movable position for illustrating a pan/tilt or zoom control process;

FIG. 7 is a reference for illustrating a process of photographing an object in center of the screen at an appropriate distance when an object is captured in a photographing region;

FIG. 8 is a functional block diagram for illustrating an image storing and transmitting process;

FIG. 9 shows a face template (a) and an input image (b) used for retrieving a face portion;

FIG. 10 is a flow chart for illustrating outline of the step of processing image signals in order to explain the method for photographing/recognizing a face according to one embodiment of the present invention;

FIG. 11 is a flow chart for illustrating a face data normalizing process;

FIG. 12 shows contour sampling arrays of the face data;

FIG. 13 is a flow chart for illustrating the step of adjusting strength of the contour of the face data according to difference in brightness;

FIG. 14 shows a template around eyes;

FIG. 15 shows a template (a) and contour data (b) around mouth;

FIG. 16 is a block diagram for illustrating method for photographing/recognizing a face according to another embodiment of the present invention;

FIG. 17 is a flow chart for illustrating the method for photographing/recognizing a face implemented in FIG. 16; and

FIG. 18 is a flow chart for illustrating another method for photographing/recognizing a face implemented in FIG. 16.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 to FIG. 14 are block diagrams of circuit configuration and flow charts of signal process for illustrating face photographing/recognizing method and apparatus according to one embodiment of the present invention. FIG. 16 to FIG. 18 are a block diagram and flow charts for illustrating face photographing/recognizing method and apparatus according to another embodiment of the present invention.

At first, one embodiment of the present invention is described in detail referring to FIG. 1 to FIG. 15.

FIG. 1 is a schematic block diagram for showing circuit configuration for implementing the apparatus for photographing/recognizing a face.

As shown in the figure, the apparatus of the present invention includes an image input unit 10 for receiving serial image signals by capturing image of an object photographed by a camera installed in a predetermined position. The apparatus also includes a pan/tilt or zoom driving unit 20 for moving the camera of the image input unit 10 to right/left, up/down or forward/backward direction. The apparatus also includes a main controller 30 for controlling the pan/tilt or zoom driving unit 20 such that the camera tracks motion of the object. The main

controller 30 also selects a check area by detecting skin color and motion of the object from the image signals inputted from the image input unit 10. The main controller 30 also retrieves face portions from the image signals in the selected check area, and then stores and transmits the face portion of the image signals to a display discussed below. The apparatus is also provided with a storing or retrieving unit 50 for storing the image signals from the main controller 30 or retrieving face portion from the image signals. The display 40 is of course included in the apparatus for outputting the image signal corresponding to the face portion outputted from the main controller 30.

In addition, the apparatus of the present invention may include an alarm generating unit 60 for generating alarm by using a visual display, an audio device according to results of face retrieval from the main controller 30.

The image input unit 10 is installed to be movable to a up/down, right/left or forward/backward direction with use of the pan/tilt or zoom driving unit 20 mounted outside. In addition the image input unit 10 includes a camera (e.g. a digital camera in the present invention) for converting the image captured in lens into an image signal which is defined in a format for digital process (e.g. RGB or YUV). The image input unit 10 also may include an image processor for processing the image signal in a regular frame interval and then providing serial digital image

data (e.g. 15-30 frames per second).

FIG. 2 is a block diagram for showing functional inner configuration of the main controller 30 of FIG. 1. As shown in the figure, the main controller 30 includes an initial analyzing unit 31 for selecting a check area by sampling portions which show skin color or motion from the input images from the image input unit 10. The main controller 30 also includes a determining unit 32 for sampling contour of the face from the check area, comparing the contour with a predetermined face template, determining whether the face is existing or abnormal according the comparison, and then selecting an object for tracking. The main controller 30 includes an object managing unit 33 for determining whether the object for tracking selected by the determining unit 32 is positioned in center of photographing region, and then calculating and outputting adjustment value of the camera for tracking motion of the corresponding object. The main controller 30 also includes a pan/tilt or zoom control unit 34 for generating a pan/tilt or zoom control signal in order to move the image input unit 10 to a right/left, up/down or forward/backward direction according to the adjustment value of the object managing unit 33. In addition, the main controller 30 includes an image storing and transmitting unit 35 for storing face image captured by the image input unit 10 and transmitting the image to the display 40 and the storing or retrieving unit 50, respectively. The main controller 30 also includes a

face recognizing and retrieving unit 36 for recognizing and retrieving the stored face image, and then transmitting the results to the alarm generating unit 60.

The initial analyzing unit 31, as shown in FIG. 3, detects a moving portion S316 by comparing a current image data S314 sampled from an input image signal S313 with image data S315 previously stored. The initial analyzing unit 31 then detects a portion, of which proportions of color elements (e.g. red R, green G, blue B or YUV) are in range of skin color, in the image signal from the image input unit 10, S317. The initial analyzing unit 31 then selects a portion where both skin color and motion are detected as a check area, S318.

The determining unit 32, as shown in FIG. 4, samples a contour of face in the check area D selected from a camera photographing region S by the initial analyzing unit 31, S411. After that, the determining unit 32 converts size of a previously stored face template into that of the check area D, and then compares the template with the contour. Then, if a contour approximate to the face template is detected in the check area D, the determining unit 32 recognizes that the face exists in the check area D, S412.

In addition, as shown in FIG. 5, after determining that a face exists by comparing the template with the contour S511, the determining unit 32 determines whether there is a previous object for tracking, S512. After

the determination, the determining unit 32 selects an object for tracking with results of the comparison between the currently selected image data and the previously stored image data, S513, S514. At this time, in case that two or more objects for tracking are detected, the determining unit 32 selects an image most approximate to the previously stored object for tracking as a new object for tracking, S514. If there is no previously object for tracking, the determining unit 32 selects an image nearest to center of the photographing region as a new object for tracking, S513.

The object managing unit 33, as shown in FIG. 6, reads location (SX, SY) of a screen in whole region which can be photographed with the camera and then determines whether the object of tracking selected by the determining unit 32 is positioned in center of the camera photographing region (x, y). At the same time, the object managing unit 33 calculates location (MX, MY) to which the screen will move, about the whole area (Pmax, Tmax) which can be ranged by the camera through pan/tilt control, and then outputs camera adjustment value to the pan/tilt or zoom control unit 34.

As shown in FIG. 7, the pan/tilt or zoom control unit 34 generates a pan/tilt or zoom signal in order to move the camera of the image input unit 10 to a right/left, up/down or forward/backward (toward paper/opposite paper in the figure) direction according to the camera adjustment value from the object managing unit 33. If an object (d) is

detected by the camera as shown in FIG. 7 (B), the pan/tilt or zoom control unit 34 positions the object (d) to center of the screen as shown in FIG. 7 (C).

As shown in the signal flow of FIG. 8, the image storing and transmitting unit 35 converts face image S611 captured by the image input unit 10 into a regular size S612, and then stores the face image in shape of bit map picture BMP S613. The image storing and transmitting unit 35 then stores the face image in a small format type (e.g. JPEG) for a predetermined long time. In addition, the image storing and transmitting unit 35 transmits the image of the object for tracking to the display 40 for displaying the image on the screen S615, or transmits to the face recognizing and retrieving unit 36 for recognizing the face S616.

The face recognizing and retrieving unit 36 retrieves characteristics of a person in order to find a face of the peculiar person from the input face data. The face recognizing and retrieving unit 36 then outputs a face image data corresponding to the characteristics (same characteristics of the face template of FIG. 9 (a) and the face image of FIG. 9 (b)).

FIG. 10 is a flow chart for illustrating outline of an image signal process for explaining one embodiment of the face photographing/recognizing method according to the present invention.

As shown in the figure, the face photographing/recognizing method according to one embodiment of the present invention includes initial

analyzing steps S101-S109, determining steps S111-S119, and an image storing and transmitting step S121. The initial analyzing steps S101-S109 selects a check area by sampling portions having skin color and motion from the input image photographed through the image input unit 10 installed to a predetermined position. The determining steps S111-S119 selects an object for tracking by sampling a face contour from the selected check area, comparing the contour with a predetermined face template, and then determining whether the face is existing or abnormal according to the comparison. The image storing and transmitting step S121 recognizes and retrieves the face image captured by the image input unit 10, and then stores the inputted face image and the contour of the object for tracking sampled from the face image.

Though not shown in the figure, another embodiment of the present invention may include an object managing step and a pan/tilt or zoom control step. The object managing step determines whether the object for tracking selected in the determining step is positioned in center of the camera photographing region, and then calculates a camera adjustment value for tracking motion of the corresponding object for tracking. The pan/tilt or zoom control step controls pan/tilt or zoom function in order to move the image input unit 10 to a right/left, up/down or forward/downward direction according to the camera adjustment value calculated in the object managing step.

Still another embodiment of the present invention may further include an alarm generating step S120 for generating alarm when the face is abnormal after analyzing and retrieving the face contour in the sampled check area.

In addition, further another embodiment of the present invention may include the steps of generating 3-dimensional information for a face image in the check image in case that the face is existing in the check area, composing a personal mask with use of the 3-dimensional information, and then recognizing a specific person by comparing the composed personal mask with person masks previously stored in, such as, database, such that it can be applied to face image recognition.

Furthermore, the present invention may store an instantaneous face image (face image in a still picture) which is accurately photographed in the check area through the initial analyzing step and the pan/tilt or zoom control step in a separate storing unit such that the instantaneous face image can be applied to an image recognizing device for a investigation purpose, a security device designed for regulating machines by recognizing a face, and so on.

FIG. 11 is a flow chart for illustrating a face data normalizing process with arrays of eyes. FIG. 12 shows contour sampling arrays of the face data. FIG. 13 is a flow chart for illustrating the step of adjusting strength of the contour of the face data according to difference in

brightness. FIG. 14 shows a template around eyes and FIG. 15 shows a template (a) and contour data (b) around mouth.

Operation and effect of the present invention will be explained referring to the figures.

Referring to FIG. 11, an inclination is examined by using arrangement of the eyes retrieved from the face data, S711. The face data is then normalized S712, so that a face data having a regular size and shape can be sampled S713.

Referring to FIG. 13, at first, characteristics of the contour in eyes, nose, mouth, eyebrows of an input face data are sampled S811. Arrangements of the sampled contour are substituted with each pixel S812. In addition, in order to determine strength of brightness, an average brightness is calculated from the input face data S813. After that, the average brightness is compared with brightness of the pixels S814 so to generate a horizontal contour sampling data S815.

At first, a digital image inputted from the camera of the image input unit 10 is defined in a format for digital process (e.g. RGB or YUV) and provides resolution (e.g. having 640×480 pixels) required to the image processor. At this time, the current input image is compared with a previous input image, and then updated as a reference image (another previous input image for next input image). In addition, a check area is selected by detecting skin color and motion of an object for tracking

through comparison between the current input data and the previous input data.

After that, the initial analyzing unit 31 of the main controller 30 selects a range for retrieving by detecting a portion having skin color consisted of RGB proportions and motion through image sampling of the image data from the image input unit 10. The initial analyzing unit 31 stores the data after detecting the portion and motion, and then uses the data for detecting motion of next image. In addition, the initial analyzing unit 31 selects check area by using motion and transmits the check area to the determining unit 32.

The determining unit 32 then determines whether the face is existing by retrieving the check area analyzed in the initial analyzing unit 31. On the purpose of that, the determining unit 32, at first, detects a contour where a center portion is dark and upper and lower portions are bright from the image signal of the check area as shown in FIG. 12. As a result of the contour detection, a contour S815 in which eyebrows, eyes, lower part of nose and mouth are outstanding can be obtained. The determining unit 32 then determines the face existing in the check area in case that the contour in the check area indicates higher value than a reference value through comparison with a previously stored face template. Because the check area does not have a regular size, size of the previously stored template should be changed before the comparison.

After that, the object managing unit 33 selects an object for tracking by comparing a current sampled face data with a previous data. If one face is detected in a new screen, the face becomes an object for tracking, while two or more faces are detected, one most approximate to the previous object is selected as an object for tracking. If there is no previous object for tracking, a face nearest to center of the screen becomes selected as an object for tracking.

Next, the pan/tilt or zoom control unit 34 is for operating the camera to track the object in case that the object for tracking is not positioned in center of the camera. The pan/tilt or zoom control unit 34 includes the pan/tilt or zoom driving unit 20 attached to the camera of the image input unit 10 such that the camera can be operated by commands from the pan/tilt or zoom control unit 34 of the main controller. The pan/tilt or zoom driving unit 20 is connected to the pan/tilt or zoom control unit 34 through serial, parallel, universal serial bus USB, or wireless communication.

After retrieving the input face images, the image storing and transmitting unit 35 stores an input face image in a separate storing unit in a picture type, and transmits the image together with the characteristics sampled for a recognizing system.

The face image retrieving unit 36 detects characteristics of a specific person in order to find a face in the input face data. The face image

retrieving unit 36 then outputs a face image data corresponding to the characteristics.

At this time, the processed data (input data) is a rectangular image data in which only face portion is sampled. Size of the data may be different each other according to size of a face, and inclination of the data is not aligned.

Therefore, the process for checking a face, at first, retrieves eyes with characteristics of face components with use of the face data, as shown in FIG. 10, S101, S103. Then, the process normalizes the face data with use of arrays of the eyes in order to make size and shape of the face uniformed as shown in FIG. 11, S105.

After that, the process samples a contour of each component of the face having uniform size and shape S107, S109, and then retrieves eye portions with use of an eye template S111 so to determine error by examining the retrieved eyes in detail S113.

Sequentially, the process retrieves a mouth portion with use of mouth and mouth surrounding templates S115, and therefore determines error through detail examination for the retrieved mouth S117.

In addition, with use of nose and nose surrounding templates and eyebrows and eyebrow surrounding templates (not shown in the figures), the process may retrieve a nose portion and eyebrow portions in order to determine error through detail examination for the retrieved nose and

eyebrows.

Then, the process synthetically determines error with use of results from the examination for the eyes and the mouth (possibly, nose and eyebrows), S119.

If there is no error as a result of the eye, nose, mouth, eyebrow or synthetic determination, the process writes and stores a face picture of the person and transmits the retrieved data to a door managing system or a passenger identifying system with use of image recognition, S121. Therefore, if any problem is occurred, a problematic person can be easily retrieved with use of any retrieving program.

On the other hand, if there is error as a result of the eye, nose, mouth, eyebrow or synthetic determination, the process determines the person having a risk factor, for example with a mask, dark sunglasses, a pressed-down cap. In this case, the process generates alarm such that a supervisor or a serviceman may cope with the emergency situation, S120.

The present invention as described above can accurately photograph a face in a rapid speed with use of a camera installed in an entrance door, which enables to write a face of a passenger. In addition, capacity of the storing unit can be remarkably reduced in fact that the present invention stores only a still picture instead of moving pictures which are employed in the prior art.

Moreover, in case that an abnormal person who enters with a mask,

dark sunglasses or a cap pressed down, that is, a person having a risk factor appears, the present invention generates alarm to a supervisor or a serviceman in advance in order to cope with an emergency situation.

In addition, because a camera which tracks motion of a face is installed in a door, the present invention can make criminals cowered, which can prevent crimes more effectively than any other supervising systems.

Furthermore, the present invention may overcome inconvenience of the prior art which needs to show a face to a fixed camera because the camera intelligently moves to an up/down or right/left direction in order to show a face in front accurately in case of using such as picture phone.

In addition, the present invention provides a more convenient function because the camera can correspond to a tall or little person, which is impossible for the prior art.

The present invention also has much more advantages in that the present invention may identify a passenger in connection with a door system, or can be used to an animation manufacturing or an on-line real time simulation game using automatic image tracking.

Hereinafter, another embodiment of the face recognizing method according to the present invention will be described with reference to FIG. 16 to FIG. 18 in detail.

FIG. 16 is a block diagram for illustrating configuration of a face photographing/recognizing system for implementing the face recognizing method according to another embodiment of the present invention.

As shown in the figure, an image input unit 100 photographs an object through a plurality of cameras toward predetermined directions. In general, the image input unit 100 employs at least two CCD cameras 110.

A preprocessing unit 200 receives an image signal from the image input unit 100. The preprocessing unit 200 eliminates noise in the image signal and then samples a contour about the image signal.

A characteristic sampling unit 300 samples characteristics of the image signal on the basis of the contour of the image signal inputted from the preprocessing unit 200.

A 3-dimensional information sampling unit 400 rearranges image by rotating, zooming or moving the image signal from the preprocessing unit 200 with use of the characteristics sampled by the characteristic sampling unit 300, and then samples 3-dimensional information with use of displacement information between the rearranged images.

A mask generating unit 500 compares the 3-dimensional information sampled from the 3-dimensional information sampling unit 400 with a predetermined reference mask, and then generates a new mask peculiar to each person.

A database 600 includes a plurality of image data obtained from image signals of proper users as a masking data.

A shape recognizing unit 700 is generally a central processing unit CPU. The shape recognizing unit 700 compares the new mask generated in the mask generating unit 500 with the masking data in the database 600, and then determines whether the new mask is same as the masking data. At this time, if there is a mask same as the new mask in the database 600, the current image photographed through the camera is recognized as a previously registered mask and the user is classified as a proper user. Or else, the image is recognized as an unregistered mask and the user is classified as an improper user.

A storing media 800 includes an operating program for overall system and a plurality of data required for recognizing faces. Such storing media 800 operates according to a control signal from the shape recognizing unit 700 so to output the previously stored data to the shape recognizing unit 700. The storing media 800 can be a card having semiconductor memory, a hard disk, an optical disk, etc.

The image input unit 100 may include the CCD camera 110 for photographing an object, an image capturing unit 120 for capturing signal from the camera in order to display the signal in a designated type, a camera driving control unit 130 for outputting a camera driving control signal by calculating a current rotating range of the CCD camera with use

of a check area selected from the characteristic sampling unit 300, and a camera driving unit 140 for rotating the camera to a specific direction according to the camera driving control signal of the camera driving control unit 130.

FIG. 17 is a flow chart for illustrating the face photographing/recognizing method according to another embodiment of the present invention. As shown in the figure, the method includes steps S200-S250 of selecting a check area for an image signal captured through the camera, detecting characteristics from the corresponding check area, rearranging the image, detecting a portion where a face is existing through retrieval of face components, sampling and examining characteristics of the portion having a face, and then adjusting direction of the camera with determining whether a face exists. The method further includes a step S260 of rearranging again the rearranged image about the image signal having a face in the check area by the characteristics, generating 3-dimensional information according to displacement information between the rearranged images, and the composing a face mask of the object with use of the 3-dimensional information. The method also further includes a step S270 of determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in the database.

FIG. 18 is a flow chart for illustrating the face

photographing/recognizing method according to another embodiment of the present invention. The method includes steps S300-S340 of selecting at least one check areas by respectively sampling skin color data and motion data from image signals inputted through cameras, matching the template with the face components with use of brightness difference in the corresponding area, and adjusting direction of the cameras after determining whether a face exists. The method also includes steps S350-S370 of rearranging images about image signals where a face is existing in the check area, generating 3-dimensional information according to displacement between the rearranged images, and composing a personal face mask by comparing the 3-dimensional information with a reference mask. The method also further includes steps S380-S400 of determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in a database.

Each embodiment of the present invention as constructed above is operated as follows.

At first, operation of an embodiment in FIG. 17 is explained with reference to the block diagram in FIG. 15.

The image input unit 100 receives image signal from the CCD camera 110 and the image capturing unit 120. The preprocessing unit 200 eliminates noise, and then executes contour correction and filtering.

The image signal processed in such a manner is then inputted to the

characteristic detecting unit 300. The characteristic detecting unit 300 generates motion data by detecting motion of an object through comparison between a previous image and a current image of the image signal. The characteristic detecting unit 300 generates a skin color data by detecting a portion in which proportions of color elements (e.g. R(red), G(green), B(blue) or YUV) are in range of skin color.

The characteristic detecting unit 300 selects at least one check areas from a image signal from a field inputted from the image input unit 100 and the preprocessing unit 200 with use of the motion data and the color data generated as above, S210. The characteristic detecting unit 300 selects a region where a face is existing by identifying the face components from the selected check area S210-1, and then rearranges the input image from the CCD camera 110 and the preprocessing unit 200 with use of the characteristics, S220.

The motion and skin color data of the generated check area, the detected characteristics, and the rearranged image data of the check area are inputted to the 3-dimensional information sampling unit 400 and the camera driving control unit 130, respectively.

The camera driving control unit 130 compares the motion and skin color data of the generated check area, the detected characteristics, and the rearranged image data with previously inputted and processed check area data.

The camera driving control unit 130 also calculates moving distance of the check area by comparing the data of two check area as described above, S230. In addition, by rotating the CCD camera 110 as much as the moving distance, rotating distance and angle are determined in order to photograph the object again.

The determined rotating distance and angle of the CCD camera 110 are then inputted as a camera driving control signal to the camera driving unit 140. The camera driving unit 140 receiving the camera driving control signal then rotates the CCD camera 110 as much as the predetermined rotating angle to a certain direction, S240. Such camera control operation is repeated whenever a new object is detected.

On the other hand, the 3-dimensional information sampling unit 400 receiving the motion and skin color data of the check area, the detected characteristics, and the rearranged image data from the characteristic detecting unit 300 then rearranges the image one more time with use of the detected characteristics, and then determines whether a face is existing in the check area with use of the rearranged characteristics of the image, S250.

As a result of the determination, 3-dimensional information for an image signal having a face in the check area is generated with use of the displacement information between a plurality of the rearranged images. In addition, by comparing the generated 3-dimensional information with

a reference mask in the mask generating unit 500, a new personal mask is generated, S260.

Then, The new generated mask is compared with a mask data in the database 600 in order to determine whether same mask exists in the database. If same mask data exists in the database 600, the new mask is recognized as a registered mask and then the object currently captured through the camera is classified as a proper user. On the other hand, if there is no same mask in the database 600, the new mask is recognized as an unregistered mask and then the object is classified as an improper user, S270.

Operation of the embodiment in FIG. 18 is explained in conjunction with the block diagram in FIG. 16.

When an image signal is inputted through the CCD camera 110 and the image capturing unit 120 of the image input unit 100 and the preprocessing unit 200, the characteristic detecting unit 300 determines the input signal and then compares a current screen with a previous screen of the image signal. According to the comparison, motion of an object can be detected to generate a motion data, and a portion in which proportions of color elements (e.g. R, G, B or YUV) are in range of skin color is detected to generate a color data, S310.

In addition, the characteristic detecting unit 300 selects at least one check area from the image signal on one field with use of the color data

and the motion data generated in the above process, S320.

When the check areas are selected, the method of this embodiment detects a portion where a face is existing through examination of face components S320-1, and then picks out the object for tracking in the corresponding area. The image is rearranged by the characteristics detected by the characteristic detecting unit 300 S330, and then the present invention identifies presence of the object for tracking in the corresponding area from the rearranged image S340. If there is a face of the object for tracking in the corresponding area, the image is rearranged after finely adjusting the camera such that the image signal having a face in the corresponding area is positioned in center of the screen, S350. Then, 3-dimensional information is generated with use of displacement information among a plurality of the rearranged images S360. The 3-dimensional information is compared with a reference mask in the mask generating unit 500 so to generate new masks each of which is personally different, S370.

If there is no accurate face, the camera is adjusted to return to a normal position (ordinary photographing position) by calculating a camera adjustment value indicating amount of the camera to move, S341. Then, the method of this embodiment executes a step S310 of generating skin data and motion data with receiving the image signal.

The new mask generated as above is compared with a mask data in

the database 600 so to determine whether the new mask exists in the database S380. As a result of the determination, if same mask exists in the database 600, the new mask is recognized as a registered mask S390 and the object currently captured by the camera is classified as a proper user. If there is no same mask in the database 600, the new mask is recognized as an unregistered mask, and the object becomes classified as an improper user.

Therefore, the present invention described above identifying a face of a person by sampling skin data and motion data from an image signal may repeatedly adjust position of the camera until recognizing the face fully by rotating the camera to a certain direction in case that the face is not recognized accurately, which gives advantage that the present invention may intelligently photograph an accurate face without a user for the recognizing system moving to a designated position.

The face photographing/recognizing method and apparatus according to the present invention has been described in detail. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

What is claimed is:

1. Method of photographing a face comprising:

initial analyzing step for identifying position of the face by sampling face data from image signals inputted from a camera installed in a predetermined position, and then selecting check area in order to track the identified face;

pan/tilt or zoom control step for moving the camera to right/left, up/down or forward/backward direction in order to track the identified face in the selected check area;

determining step for determining whether the face is existing or abnormal by sampling and analyzing contour of the face identified in the check area; and

storing and transmitting step for storing image of the determined face or transmitting the image to another recognizing system.

2. Method of photographing a face as claimed in claim 1, further comprising the step of generating alarm about abnormal face after analyzing and determining the contour of the face sampled in the check area.

3. Method of photographing a face as claimed in claim 2, wherein

the initial analyzing step comprises the steps of:

detecting a moving portion by comparing a currently sampled image date with a previously stored image data;

detecting a portion, in which proportions of color elements are in range of skin color, from the currently sampled image data; and

selecting a portion where both skin color and motion are detected as a check area.

4. Method for photographing a face as claimed in claim 3, wherein the initial analyzing step selects nearer image on the basis of a previously selected object for tracking as a new object for tracking in case that at least two faces are identified in the check area.

5. Method for photographing a face as claimed in claim 4, wherein the initial analyzing step selects near image to center of photographing region as a new object for tracking in case that there is no previously selected object for tracking.

6. Method for photographing a face as claimed in claim 2, wherein the determining step adjusts strength of the contour according to characteristics of person and/or surroundings by sampling the contour of the face on the basis of average brightness of the image data in the

check area.

7. Method for photographing a face as claimed in claim 6, wherein the determining step compares the contour of the image data sampled in the check area with a predetermined face template, and determines that the face exists in the check area when a contour approximates to the face template.

8. Method for photographing a face as claimed in claim 7, wherein the determining step compares the predetermined face template with the contour in the check area by converting size of the predetermined face template to size of the check area.

9. Method for photographing a face as claimed in claim 7, wherein the determining step comprises the steps of:

determining whether eyes are normal by partially retrieving the eyes after substituting the sampled face contour for a predetermined template around eyes:

determining whether nose and mouth are normal by partially retrieving the nose and the mouth after substituting the sampled face contour for a predetermined template around nose and mouth, after completing the partial retrieving for the eyes; and

determining whether the face is wholly normal by substituting numerical data of the sampled face contour for predetermined numerical data of the eyes, the nose and the mouth, after completing the partial retrieving for the nose and the mouth.

10. Method for photographing a face as claimed in claim 2, wherein the face image storing and transmitting step retrieves and stores the face image among inputted data separately.

11. Method for recognizing a face comprising:

initial analyzing step for identifying position of the face by sampling face data from image signals inputted from a camera installed in a predetermined position, and then selecting check area in order to track the identified face;

pan/tilt or zoom control step for moving the camera to right/left, up/down or forward/backward direction in order to track the identified face in the selected check area;

determining step for determining whether the face is existing or abnormal by sampling and analyzing contour of the face identified in the check area; and

composing a personal mask by generating 3-dimensional information for a face image in the check area in case that the face is

existing, and then recognizing a specific person by comparing the personal mask with a previously stored personal mask.

12. Method for recognizing a face as claimed in claim 11, further comprising the step of generating alarm about abnormal face after analyzing and determining the contour of the face sampled in the check area.

13. Method for recognizing a face as claimed in claim 12, wherein the initial analyzing step comprises the steps of:

detecting a moving portion by comparing a currently sampled image date with a previously stored image data;

detecting a portion, in which proportions of color elements are in range of skin color, from the currently sampled image data; and

selecting a portion where both skin color and motion are detected as a check area.

14. Method for recognizing a face as claimed in claim 13, wherein the initial analyzing step selects nearer image on the basis of a previously selected object for tracking as a new object for tracking in case that at least two faces are identified in the check area.

15. Method for recognizing a face as claimed in claim 14, wherein the initial analyzing step selects near image to center of photographing region as a new object for tracking in case that there is no previously selected object for tracking.

16. Method for recognizing a face as claimed in claim 12, wherein the determining step adjusts strength of the contour according to characteristics of person and/or surroundings by sampling the contour of the face on the basis of average brightness of the image data in the check area.

17. Method for recognizing a face as claimed in claim 16, wherein the determining step compares the contour of the image data sampled in the check area with a predetermined face template, and determines that the face exists in the check area when a contour approximates to the face template.

18. Method for recognizing a face as claimed in claim 17, wherein the determining step compares the predetermined face template with the contour in the check area by converting size of the predetermined face template to size of the check area.

19. Method for recognizing a face as claimed in claim 17, wherein the determining step comprises the steps of:

determining whether eyes are normal by partially retrieving the eyes after substituting the sampled face contour for a predetermined template around eyes:

determining whether nose and mouth are normal by partially retrieving the nose and the mouth after substituting the sampled face contour for a predetermined template around nose and mouth, after completing the partial retrieving for the eyes; and

determining whether the face is wholly normal by substituting numerical data of the sampled face contour for predetermined numerical data of the eyes, the nose and the mouth, after completing the partial retrieving for the nose and the mouth.

20. Method for recognizing a face comprising the steps of:

selecting a plurality of check areas about image signals captured by a camera, selecting a specific check area by determining whether a face exists in the corresponding check area, and adjusting direction of the camera according to motion of an object in the selected check area;

rearranging images by detecting characteristics about image signal where a face is existing in the check area after determining whether a face exists, generating 3-dimensional information according to displacement

between the rearranged images, and composing a face mask of the object with use of the 3-dimensional information; and

determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in a database.

21. Method for recognizing a face comprising the steps of:

selecting a plurality of check areas by respectively sampling skin color data and motion data from image signals inputted through a camera, selecting a specific check area by retrieving a specific check area by inspecting face components about image signals in the corresponding check area, rearranging image by retrieving characteristics of the selected check area, and adjusting direction of the camera with determining whether a face exists or not with use of the rearranged image;

rearranging images about image signals where a face is existing in the check area, generating 3-dimensional information according to displacement between the rearranged images, and composing a personal face mask by comparing the 3-dimensional information with a reference mask; and

determining whether image for a specific person is registered or not by searching the composed face mask from personal registration masks in a database.

22. Apparatus for photographing a face comprising:

image input means for capturing image of an object photographed by a camera installed in a predetermined position, and receiving serial image signals;

pan/tilt or zoom driving means for moving the camera of the image input means to right/left, up/down or forward/backward direction;

main control means for controlling the pan/tilt or zoom driving means such that the camera tracks motion of the object, selecting a check area by detecting skin color and motion of the object from the image signals inputted from the image input means, retrieving face portions from the image signals in the selected check area, and storing and displaying the face portions;

storing or retrieving means for storing the image signals from the main control means or retrieving face portion from the image signals; and

display means for outputting the image signal corresponding to the face portion outputted from the main control means.

23. Apparatus for photographing a face as claimed in claim 22, further comprising alarm generating means for generating alarm according to results of face retrieval from the main control means.

24 Apparatus for photographing a face as claimed in claim 23, wherein the main control means comprises:

initial analyzing unit for selecting a check area by sampling portions which show skin color or motion from input images from the image input means;

determining unit for sampling contour of the face from the check area, comparing the contour with a predetermined face template, determining whether the face is existing or abnormal according the comparison, and then selecting an object for tracking;

object managing unit for determining whether the object for tracking selected by the determining unit is positioned in center of camera photographing region, and calculating and outputting a camera adjustment value of the camera for tracking motion of the corresponding object;

pan/tilt or zoom control unit for generating pan/tilt or zoom control signal in order to move the image input means to a right/left, up/down or forward/backward direction according to the camera adjustment value from the object managing unit;

image storing and transmitting unit for storing face image captured by the image input means and transmitting the image to the display means; and

face recognizing and retrieving unit for recognizing and retrieving the

stored face image.

25. Apparatus for photographing a face as claimed in claim 24, wherein the initial analyzing unit detects a moving portion by comparing a currently sampled image data with a previously stored image data, detects a portion, in which proportions of color elements are in range of skin color, and selects a portion where both skin color and motion are detected as a check area.

26. Apparatus for photographing a face as claimed in claim 24, wherein the determining unit determines that a face exists in the check area when detecting a contour approximate to the face template after comparing the detected contour with the previously stored face template.

27. Apparatus for photographing a face as claimed in claim 26, wherein the determining unit compares the predetermined face template with the contour in the check area by converting size of the previously stored face template to the check area.

28. Apparatus for photographing a face as claimed in claim 27, wherein, when selecting an object for tracking by comparing a currently sampled image data with the previously stored image data, in case that

two or more objects for tracking are detected, the determining unit selects an image most approximate to a previously selected object for tracking as a new object for tracking.

29. Apparatus for photographing a face as claimed in claim 27, wherein, when selecting an object for tracking by comparing a currently sampled image data with the previously stored image data, in case that two or more objects for tracking are detected and there is no previously selected object for tracking, the determining unit selects an image nearest to center of photographing region as a new object for tracking.

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Other: Online: EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0598355 A1	(ALCATEL SEL) See abstract	1
X	EP 0578508 A2	(SONY) Line 4 col.3 to line 27 col.6	1
X	US 5631697	(NISHIMURA) Line 14 col.6 to line 49 col.7, and line 18 col.11 to line 22 col.12	1
X	JP 090149391	(KYOCERA) See abstract	1
X	JP 090107534	(CANON) See abstract	1

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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